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Or, putting $\frac{1}{2}(1 + \cos 2\gamma)$ and $\frac{1}{2}(1 - \cos 2\gamma)$ for $\cos^2 \gamma$ and $\sin^2 \gamma$,

$$\sin (2nt - \alpha - \beta) \cos (\alpha - \beta) - \cos 2\gamma \cos (2nt - \alpha - \beta) \sin (\alpha - \beta) = 0;$$

and then replacing t by the particular value T at this time,

$$\tan (2nT - \alpha - \beta) = \cos 2\gamma \tan (\alpha - \beta).$$

3. The major semi-axis is $k \cos \delta/2$, δ being by hypothesis an angle in the first quadrant. Differentiating

$$\frac{y}{x} = \tan \gamma \frac{\cos (nt - \beta)}{\cos (nt - \alpha)},$$

we have for the angular velocity of P

$$\frac{n \tan \gamma \sin (\beta - \alpha)}{\cos^2 (nt - \alpha)},$$

positive or negative with $\sin (\beta - \alpha)$.

We can place 2γ on the hypotenuse, 2θ and δ on the legs of a right spherical triangle, $90° - (2nT - \alpha - \beta)$ opposite 2θ and $\alpha - \beta$ opposite δ on the angles; for the three equations

$$\sin \delta = \sin 2\gamma \sin (\alpha - \beta), \qquad \cos (\alpha - \beta) = \tan 2\theta \cot 2\gamma,$$
$$\cos 2\gamma = \cot (\alpha - \beta) \tan (2nT - \alpha - \beta)$$

will then conform to Napier's rules.[1]

2878 [1921, 89]. Proposed by R. S. HOAR, Fort Banks, Mass.

Consider the integers $0, 1, 2, 3 \cdots n - 1, n$. Consider all possible permutations of combinations of these taken r at a time, allowing any integer to occur more than once. Select from these permutations all groups the sum of whose integers is n. Form the reciprocal of the product of the factorials of the r integers of each of these selected groups. Then the sum of all of these reciprocals will equal $r^n/n!$. Prove that this must be so.

Example. $n = 2$, $r = 3$.

$$\frac{1}{2!0!0!} + \frac{1}{0!0!2!} + \frac{1}{0!2!0!} + \frac{1}{1!0!1!} + \frac{1}{1!1!0!} + \frac{1}{0!1!1!} = \frac{3^2}{2!}, \quad \text{if} \quad 0! = 1.$$

SOLUTION BY H. L. OLSON, University of Michigan, and PHILIP FRANKLIN, Princeton University.

By the multinomial theorem, we have

$$(x_1 + x_2 + \cdots + x_r)^n = \Sigma \frac{n!}{i_1!i_2!\cdots i_r!} x_1^{i_1}x_2^{i_2} \cdots x_r^{i_r},$$

where $i_1 + i_2 + \cdots + i_r = n$ and $i_1, i_2, \cdots, i_r \geqq 0$. If we set each x_i equal to unity and divide the two members of the equation by $n!$, we have the theorem stated.

2880 [1921, 89]. Proposed by SIDNEY DORB, Detroit, Mich.

Solve the simultaneous equations $xy = 2$, and

$$\left(3 - \frac{6y}{x - y}\right)^2 + \left(3 - \frac{6y}{x + y}\right)^2 = 82.$$

SOLUTION BY A. A. BENNETT, University of Texas.

It is assumed for various reasons that the second equation was intended in the form

$$\left(3 + \frac{6y}{x - y}\right)^2 + \left(3 - \frac{6y}{x + y}\right)^2 = 82,$$

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[1] This supposes $\sin (\alpha - \beta)$ positive, and it would not essentially restrict the problem to assume that α and β are angles in the first quadrant, $\alpha > \beta$.